

Claims:

1. A process for coating a material surface comprising the steps of:
 - (a) applying to the material surface one or more different comb-type polymers comprising a polymer backbone and side chains pendently attached thereto, wherein at least a part of the side chains carry a triggerable precursor for carbene or nitrene formation; and
 - (b) fixing the polymer(s) onto the material surface using heat or radiation, in particular radiation such as UV or visible light.

2. A process according to claim 1, wherein the polymer backbone according to step (a) of the process comprises a polyvinyl homo- or copolymer, a polyethylene imine, a polypeptide, a polyether or a polysaccharide, and the side chains that are attached to the polymer backbone are selected from the group consisting of functional hydrophilic telomers, polyalkylene oxides, oligosaccharides and oligopeptides.

3. A process according to claim 1 or 2, wherein the comb-type polymer according to step (a) of the process is
 - (I) a polyvinyl polymer comprising units of the formula



wherein R is hydrogen or C₁-C₄-alkyl and Z₁ is a hydrophilic side chain comprising at least one one triggerable precursor for carbene or nitrene formation and having a weight average molecular weight of ≥ 200 ; or

- (II) a polyethylene imine comprising units of formula



wherein Z_2 is a hydrophilic side chain comprising at least one triggerable precursor for carbene or nitrene formation and having a weight average molecular weight of ≥ 200 ; or
 (III) a polypeptide comprising units of formula

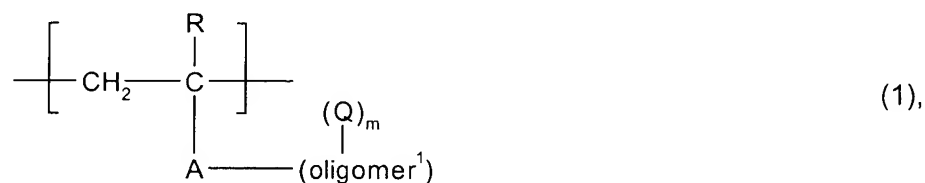


wherein Z_3 is a hydrophilic side chain comprising at least one triggerable precursor for carbene or nitrene formation and having a weight average molecular weight of ≥ 200 ; or
 (IV) a polyether comprising units of formula



wherein Z_4 is a hydrophilic side chain comprising at least one triggerable precursor for carbene or nitrene formation and having a weight average molecular weight of ≥ 200 , or
 (V) a polysaccharide comprising saccharide units to which is attached a side chain Z_5 comprising at least one triggerable precursor for carbene or nitrene formation and having a weight average molecular weight of ≥ 200 .

4. A process according to any one of claims 1 to 3, wherein the comb-type polymer according to step (a) comprises units of formula



wherein R is hydrogen or C_1 - C_4 -alkyl;

- A is a radical of formula
- $\text{C}(\text{O}) - \text{X} -$ (2a),
 - $\text{C}(\text{O}) - \text{O} - (\text{CH}_2)_r - \text{CH}(\text{OH}) - \text{CH}_2 - \text{X} -$ (2b),
 - $\text{C}(\text{O}) - \text{NH} - (\text{alk}') - \text{C}(\text{O}) - \text{X} -$ (2c),
 - $\text{C}(\text{O}) - \text{O} - (\text{alk}'') - \text{NH} - \text{C}(\text{O}) - \text{X} -$ (2d),
 - $\text{C}(\text{O}) - \text{X} - (\text{alk}'') - \text{X}_1 - \text{C}(\text{O}) -$ (2e),
 - $\text{C}(\text{O}) - \text{NH} - \text{C}(\text{O}) - \text{X} -$ (2f),
 - $(\text{alk}''')_s - \text{X} - \text{D} - \text{X}_1 -$ (2g)
 - $\text{X} - (\text{alk}') - \text{X}_1 -$ (2h),



wherein (alk') is C₁-C₆-alkylene; (alk'') is C₂-C₁₂-alkylene; (alk''') is C₁-C₆-alkylene; D is a group -C(O)- or -C(S)- and s is 0 or 1;

X and X₁ are each independently a group -O- or -NR₁-, wherein R₁ is hydrogen or C₁-C₄-alkyl;

(oligomer¹) is the radical of

(i) a hydrophilic telomer which is derived from one or more different copolymerizable vinyl monomers,

(ii) the radical of an oligosaccharide;

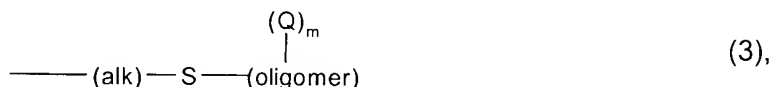
(iii) the radical of an oligopeptide; or

(iv) the radical of a polyalkylene oxide;

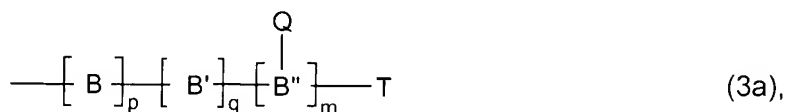
Q is a radical comprising a triggerable precursor for carbene or nitrene formation;

r is an integer from 1 to 4; and m is an integer ≥ 1 .

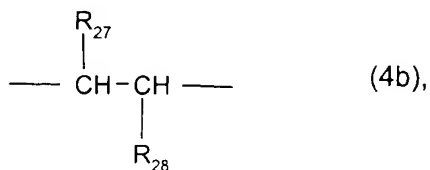
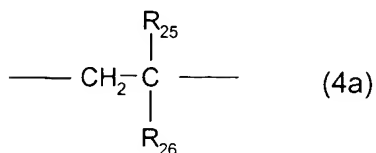
5. A process according to claim 4, wherein the radical -(oligomer¹)-(Q)_m corresponds to a radical of formula



wherein (alk) is C₂-C₆-alkylene and (oligomer)-(Q)_m corresponds to formula



wherein B and B' are each independently of the other a radical of formula



wherein R₂₅ is hydrogen or C₁-C₄-alkyl, R₂₆ is a hydrophilic substituent; R₂₇ is C₁-C₄-alkyl, phenyl or a radical -C(O)OY₉, wherein Y₉ is hydrogen or unsubstituted or hydroxy-substituted C₁-C₄-alkyl; and R₂₈ is a radical -C(O)OY₉' or -CH₂-C(O)OY₉' wherein Y₉' independently has the meaning of Y₉;

B''-Q is a 1,2-ethylene radical of formula

$$\begin{array}{c} \text{R}_{25}'' \\ | \\ \text{---CH}_2\text{---C---} \\ | \\ \text{A}_1 \end{array} \text{---} \text{C}_6\text{H}_4 \text{---} \text{C}(\text{R}_{29})_g \text{---} \text{L}_1 \quad (4c),$$

wherein R₂₅' is hydrogen or C₁-C₄-alkyl,

A_1 is a linking member of formula

$$-C(O)-X'- \quad (6a),$$
$$-(\text{CH}_2)_t-\text{X}'-\text{C}(\text{O})- \quad (6b),$$
$$-C(O)-X'-(Alk)-X_2-C(O)- \quad (6c),$$
$$-(\text{CH}_2)_1-\text{X}'-\text{D}_1-\text{NH}- \quad (6d),$$
$$-C(O)-X'-(Alk)-X_2-A_2-NH- \quad (6e), \text{ or}$$
$$-(\text{CH}_2)_t-\text{X}'-\text{CH}_2-\text{CH}(\text{OH})-\text{CH}_2- \quad (6f),$$

X' and X₂ are each independently a group -O- or -NR₁'-, R₁' is hydrogen or C₁-C₄-alkyl; D₁ is a group -C(O)- or -C(S)-, (Alk) is C₂-C₁₂-alkylene, t is 0 or 1,

R₂₉ is C₁-C₄-alkyl, C₁-C₄-alkoxy, amino, hydroxy, sulfo, nitro, trifluoromethyl or halogen,
q is an integer from 0 to 2,

L_1 is a group of formula

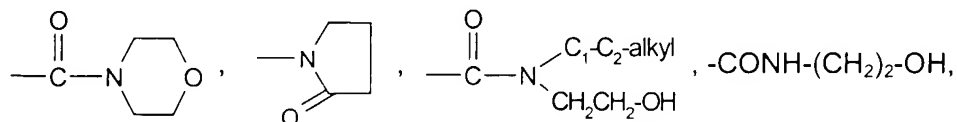
$$\begin{array}{ccc} \begin{array}{c} \text{N} \\ \diagup \quad \diagdown \\ \text{---} \quad \text{N} \\ | \\ \text{R}_{30} \end{array} & (7a), \quad \text{or} & \text{---N}_3 \quad (7b), \end{array}$$

R₃₀ is fluorinated C₁-C₆-alkyl,

p and q are each independently of another an integer from 0 to 250, wherein the total of (p+q) is an integer from 2 to 250, m is an integer from 1 to 3, and

T is a monovalent group that is suitable to act as a polymerization chain-reaction terminator.

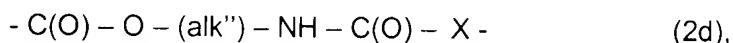
6. A process according to claim 5, wherein B and B' are each independently a radical of formula (4a), R₂₅ is hydrogen or methyl, and R₂₆ is a radical -CONH₂, -CON(CH₃)₂,



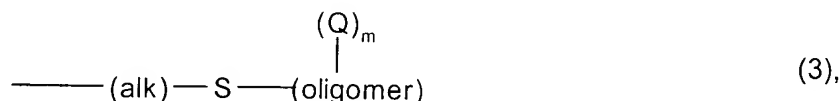
-COO(CH₂)₂₋₄-NHC(O)-O-G, wherein -O-G is the radical of trehalose, -COOH, -NH₂, -CH₂-NH₂, -CH₂-N(CH₃)₂, -C(O)NH-(CH₂)₂₋₃-NH₂, -C(O)O-(CH₂)₂₋₃-NH₂,

-COO-(CH₂)₂-N(CH₃)₂ or -C(O)O-CH₂-CH(OH)-CH₂-N(CH₃)₃⁺An⁻, wherein An⁻ is an anion.

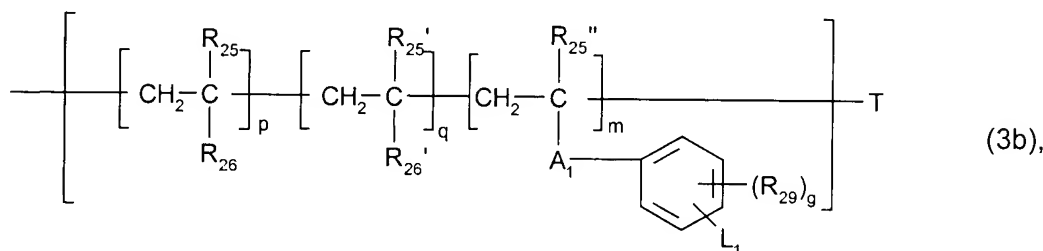
7. A process according to any one of claims 4 to 6, wherein in the polymer units of formula (1) R is hydrogen or methyl, A is a radical of formula



(alk'') is C₂-C₄-alkylene; X is -NH-; and (oligomer¹)-(Q)_m is a telomer radical of formula



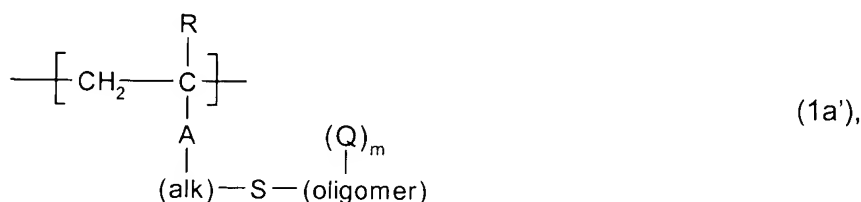
wherein (alk) is C₂-C₄-alkylene and (oligomer)-(Q)_m corresponds to formula



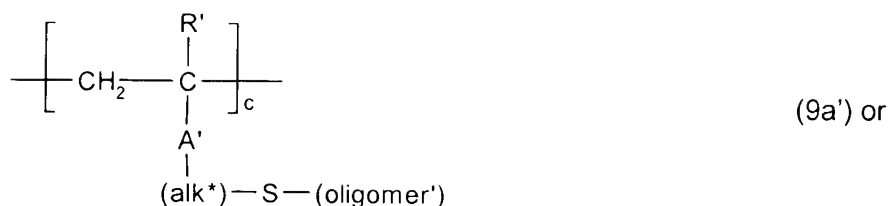
wherein R₂₅, R₂₅' and R₂₅'' are each independently hydrogen or methyl, R₂₆ is a radical -CONH₂, -CON(CH₃)₂ or N-pyrrolidonyl, R₂₆' is -NH₂ or -C(O)X'-(Alk)-NH₂, X' is -O- or -NH-, (Alk) is C₂-C₃-alkylene, A₁ is a radical -NH-C(O)- or -C(O)-NH-(CH₂)₂₋₄-NH-C(O)-, g is 0, L₁ is a radical $\begin{array}{c} \text{CF}_3 \\ \diagup \quad \diagdown \\ \text{N} \end{array}$ or -N₃, p and q are each independently an integer from 0 to 150,

wherein the total of (p+q) is an integer from 2 to 150, m is an integer from 1 to 3, and T is a monovalent group that is suitable to act as a polymerization chain-reaction terminator.

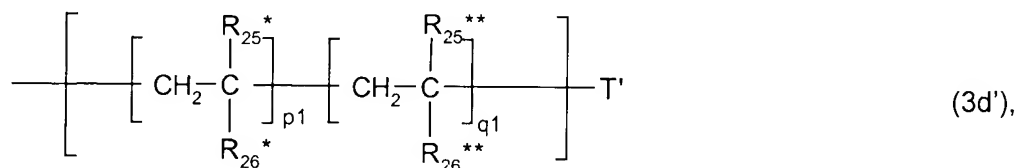
8. A process according to any one of claims 1 to 7, wherein the comb-type polymer according to step (a) is a polymer comprising units of formula



and optionally



wherein R, R' and R_{25a} are each independently hydrogen or methyl, R_{26a} is a radical -CONH₂, -CON(CH₃)₂ or N-pyrrolidonyl, A and A' are each independently a radical of the above formula (2a), (2c), (2d), (2i) or (2k) given in claim 4, wherein X is a group -O- or -NH-, (alk)'' is C₂-C₄-alkylene, (alk') is a radical -CH₂- or -C(CH₃)₂-, and (alk''') is C₁-C₂-alkylene, (alk) and (alk*) are each independently C₂-C₄-alkylene, (oligomer)-(Q)_m is a radical of formula (3b) according to claim 7, and (oligomer') is a radical of formula



wherein R₂₅^{*} and R₂₅^{**} are each independently hydrogen or methyl, R₂₆^{*} and R₂₆^{**} are each independently a radical -CONH₂, -CON(CH₃)₂ or N-pyrrolidonyl, p₁ and q₁ are each independently an integer of from 0 to 150 and the total of (p₁+q₁) is an integer from 2 to 150, and T' is a monovalent group that is suitable to act as a polymerization chain-reaction terminator.

9. A process according to claim 8, wherein the comb-type polymer according to step (a) essentially consists of units of formula (1a').

10. A process according to claim 8, wherein the comb-type polymer according to step (a) essentially consists of units of formula (1a') and optionally (9a').

11. A process according to any one of claims 1 to 10, wherein the material surface to be coated is the surface of a biomedical device, particularly a contact lens, intraocular lens or artificial cornea.

12. A composite material comprising

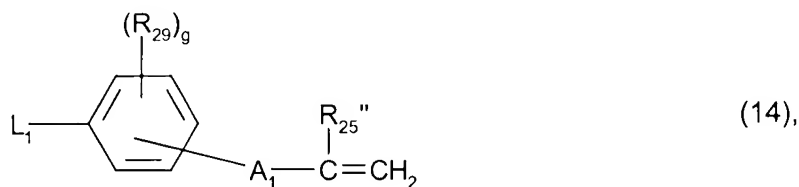
(i) an inorganic or organic bulk material; and

(ii) a hydrophilic surface coating obtainable by the process according to any one of claims 1 to 11.

13. Use of a comb-type polymer comprising a polymer backbone and side chains pendently attached thereto, wherein at least a part of the side chains carry a triggerable precursor for carbene or nitrene formation for the modification of a material surface, in particular of a surface of a biomedical article.

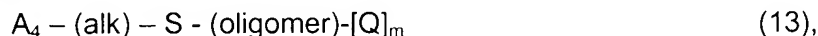
14. A polymer comprising units of formula (1a), (1b), (1c) or (1d) according to claim 3.

15. A compound of formula

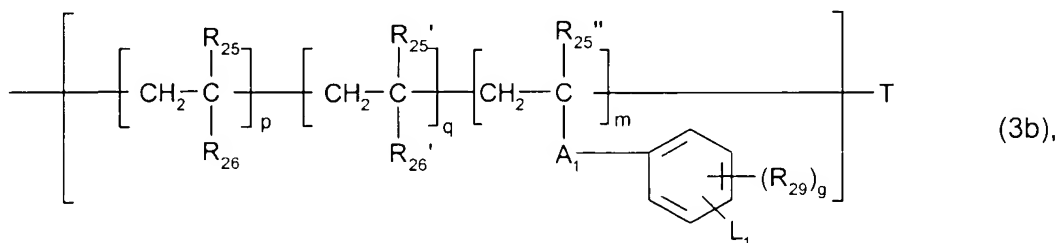


wherein A_1 , L_1 , R_{25}'' , R_{29} and g are each as defined in claim 5.

16. A telomer of formula



wherein A_4 is hydroxy, amino, carboxy or a derivative thereof, (alk) is C_2 - C_6 -alkylene, and (oligomer)- $[Q]_m$ is a radical of formula

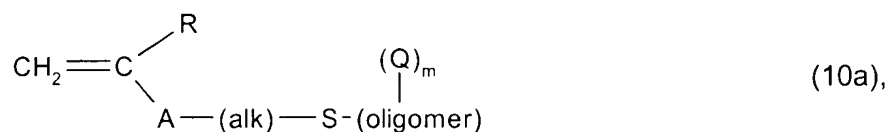


wherein R_{25} , R_{25}' and R_{25}'' are each independently hydrogen or C_1 - C_4 -alkyl, R_{26} and R_{26}' are each independently a hydrophilic substituent,

p and q are each independently of another an integer from 0 to 250, wherein the total of $(p+q)$ is an integer from 2 to 250, m is an integer ≥ 1 ,

T is a monovalent group that is suitable to act as a polymerization chain-reaction terminator, and R_{25}'' , R_{29} , A_1 , L_1 and g are each as defined in claim 5.

17. A macromonomer of formula



wherein R is hydrogen or C_1 - C_4 -alkyl, (alk) is C_2 - C_6 -alkylene, A is a radical of formula (2a) – (2k) given in claim 4, and $(\text{oligomer})-(\text{Q})_m$ is a radical of formula (3b) given in claim 16.

18. A biomedical article, particularly a contact lens, intraocular lens or artificial cornea, comprising a surface coating that is obtainable by fixing a polymer according to claim 14 onto its surface by the action of heat or radiation.